

7.5 Magnitude of the Equilibrium Constant

Name: _____ Class: _____ Date: _____

Total: 9 marks

Objective

Build the skills to answer exam questions on the **magnitude of the equilibrium constant**.

You must be able to:

- interpret a **large** K (products favored) and a **small** K (reactants favored)
- relate $K \approx 1$ to comparable amounts
- reason about the position of equilibrium

1 Worked examples

Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

■ What the size of K tells you

- $K \gg 1$: at equilibrium there are **mostly products** —the reaction "goes nearly to completion".
- $K \ll 1$: mostly **reactants** —the reaction "barely proceeds".
- $K \approx 1$: comparable amounts of reactants and products.

■ A worked interpretation

$K = 1 \times 10^8 \rightarrow$ very large \rightarrow products strongly favored. $K = 1 \times 10^{-6} \rightarrow$ very small \rightarrow reactants favored.

■ K is not the rate

A large K says the **position** favors products, **not** that the reaction is fast. Speed (kinetics) and extent (equilibrium) are separate ideas.

■ Comparing two reactions

The one with the **larger** K has the equilibrium lying further toward products under the same conditions.

2 Practice

Now apply the methods above.

2.1 A reaction has $K = 1 \times 10^{10}$. Are products or reactants favored? [1]

2.2 A reaction has $K = 1 \times 10^{-5}$. Are products or reactants favored? [1]

2.3 Does a large K mean the reaction is fast? [1]

3 Exam-style questions

3.1 A very large equilibrium constant means at equilibrium there are mostly [1]

- **A** reactants
 - **B** products
 - **C** equal amounts
 - **D** no molecules
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3.2 Two reactions have $K_1 = 5 \times 10^3$ and $K_2 = 2 \times 10^{-2}$.

(a) State which favors products more. [1]

(b) Describe the equilibrium mixture for reaction 2. [2]

3.3 Explain why a large K does not tell you how quickly equilibrium is reached. [2]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **7.5 Magnitude of the Equilibrium Constant** lesson on the **Learn** page;
- read the **Magnitude of the Equilibrium Constant** section of the AP Chemistry handout on the **Know** page.

Solutions

2.1 Products.

2.2 Reactants.

2.3 No.

3.1 B —mostly products.

3.2 (a) Reaction 1 (larger K). (b) Reaction 2 has a small K , so at equilibrium it is mostly reactants with little product.

3.3 K describes the extent (position) of equilibrium, which is thermodynamic; the speed of reaching it depends on kinetics (activation energy), a separate factor.